

# Claims

- [c1] An integrated laser device comprising:
  - a pre-distortion circuit having an input that receives an electrical modulation signal, the pre-distortion circuit generating a pre-distorted modulation signal at an output from the electrical modulation signal; and
  - a laser that is integral with the pre-distortion circuit, the laser having an electrical modulation input that is connected to the output of the pre-distortion circuit, the laser modulating an optical signal with the pre-distorted modulation signal, wherein the pre-distorted modulation signal causes at least some vector cancellation of distortion signals generated when the laser modulates the optical signal.
- [c2] The integrated laser device of claim 1 wherein the pre-distortion circuit comprises a shunt-type pre-distortion circuit.
- [c3] The integrated laser device of claim 2 wherein the shunt-type pre-distortion circuit comprises a non-linear electronic device.
- [c4] The integrated laser device of claim 2 wherein the shunt-

type pre-distortion circuit comprises a semiconductor diode.

- [c5] The integrated laser device of claim 1 wherein the pre-distortion circuit comprises a first and a second shunt-type pre-distortion circuit.
- [c6] The integrated laser device of claim 1 wherein the pre-distortion circuit generates a pre-distorted modulation signal that reduces an amplitude of third-order distortion signals that are generated when the laser modulates the optical signal.
- [c7] The integrated laser device of claim 1 wherein the pre-distortion circuit generates a pre-distorted modulation signal that reduces an amplitude of second-order distortion signals that are generated when the laser modulates the optical signal.
- [c8] The integrated laser device of claim 1 wherein the pre-distortion circuit generates a pre-distorted modulation signal that reduces an amplitude of temperature dependent distortion signals that are generated when the laser modulates the optical signal.
- [c9] The integrated laser device of claim 1 wherein the pre-distortion circuit generates a pre-distorted modulation signal that reduces temperature dependent distortion

signals that are generated by the pre-distortion circuit.

- [c10] The integrated laser device of claim 1 wherein the pre-distortion circuit comprises a bias input that receives a bias signal that controls the vector cancellation of distortion signals generated when the laser modulates the optical signal.
- [c11] The integrated laser device of claim 1 wherein the laser comprises a distributed feedback laser.
- [c12] The integrated laser device of claim 1 wherein the laser comprises an electro-absorption modulated laser.
- [c13] The integrated laser device of claim 1 wherein the integral laser and pre-distortion circuit are positioned within a single device package.
- [c14] The integrated laser device of claim 1 wherein the integral laser and pre-distortion circuit are fabricated on a single monolithic substrate.
- [c15] The integrated laser device of claim 1 wherein an output impedance of the pre-distortion circuit is substantially matched to an input impedance of the electrical modulation input of the laser.
- [c16] The integrated laser device of claim 1 wherein an output impedance of an amplifier that amplifies the electrical

modulation signal is substantially matched to an input impedance of the pre-distortion circuit.

- [c17] The integrated laser device of claim 1 wherein the pre-distortion circuit generates the pre-distorted modulation signal by generating a pre-distortion signal and combining the pre-distortion signal with the electrical modulation signal.
- [c18] The integrated laser device of claim 1 wherein the pre-distorted modulation signal causes vector cancellation of substantially all distortion signals generated when the laser modulates the optical signal.
- [c19] The integrated laser device of claim 1 further comprising an integral transmission line that couples the output of the pre-distortion circuit to the electrical modulation input of the laser, the integral transmission line substantially maintaining an amplitude and a phase response of the pre-distorted modulation signal.
- [c20] An optical source having reduced second-order and third-order distortions, the optical source comprising: a pre-distortion circuit having a modulation signal input that receives an electrical modulation signal, a first bias input that receives a first bias signal, and a second bias input that receives a second bias signal, the pre-

distortion circuit generating a pre-distorted modulation signal at an output from the electrical modulation signal, the first bias signal, and the second bias signal; and a laser that is integral with the pre-distortion circuit, the laser having an electrical modulation input that is connected to the output of the pre-distortion circuit, the laser modulating an optical signal with the pre-distorted modulation signal, wherein the pre-distorted modulation signal causes at least some vector cancellation of second-order distortion signals generated when the laser modulates the optical signal in response to the first bias signal and causes at least some vector cancellation of third-order distortion signals generated when the laser modulates the optical signal in response to the second bias signal.

[c21] The optical source of claim 20 wherein the pre-distortion circuit comprises a first shunt-type pre-distortion circuit having the first bias input that receives the first bias signal and a second shunt-type pre-distortion circuit having the second bias input that receives the second bias signal.

[c22] The optical source of claim 20 wherein the laser comprises a distributed feedback laser.

[c23] The optical source of claim 20 wherein the laser com-

prises an electro-absorption modulated laser.

[c24] The optical source of claim 20 wherein the laser and the pre-distortion circuit are positioned within a single device package.

[c25] The optical source of claim 20 wherein the laser and the pre-distortion circuit are fabricated on a single monolithic substrate.

[c26] The optical source of claim 20 wherein an output impedance of the pre-distortion circuit is substantially matched to an input impedance of the electrical modulation input of the laser.

[c27] The optical source of claim 20 wherein the pre-distorted modulation signal causes vector cancellation of substantially all of the first-order and substantially all of the second-order distortion signals generated when the laser modulates the optical signal.

[c28] The optical source of claim 20 further comprising an integral transmission line that couples the output of the pre-distortion circuit to the electrical modulation input of the laser, the integral transmission line substantially maintaining an amplitude and a phase response of the pre-distorted modulation signal.

[c29] A method of generating a modulated optical signal with reduced second-order and third-order distortions, the method comprising:

- generating a first bias signal that is related to second-order distortions generated during modulation;
- generating a second bias signal that is related to third-order distortions generated during modulation;
- processing an electrical modulation signal with a non-linear electronic circuit that is biased by both the first bias signal and the second bias signal, the non-linear electronic circuit generating a pre-distorted modulation signal;
- propagating the pre-distorted modulation signal through a transmission line to a modulation input of a laser, the transmission line substantially maintaining an amplitude and a phase response of the pre-distorted modulation signal; and
- modulating the laser with the pre-distorted modulation signal to generate a modulated optical signal, wherein the pre-distorted modulation signal causes at least some vector cancellation of both the second-order and the third order distortion signals generated during modulation.

[c30] The method of claim 29 wherein at least one of the first and the second bias signals is related to temperature de-

pendent distortion signals that are generated when the laser is modulated.

- [c31] The method of claim 29 wherein the modulating the laser comprises directly modulating the laser.
- [c32] The method of claim 29 wherein the modulating the laser comprises electro-optically modulating the laser.
- [c33] The method of claim 29 further comprising matching an output impedance of the non-linear electronic circuit to an input impedance of the laser.
- [c34] The method of claim 29 wherein the pre-distorted modulation signal causes vector cancellation of substantially all of the second-order and the third-order distortion signals generated when the laser is modulated.
- [c35] An optical source comprising:
  - means for generating a first bias signal that is related to second-order distortions generated during modulation;
  - means for generating a second bias signal that is related to third-order distortions generated during modulation;
  - means for non-linearly processing an electrical modulation signal in response to both the first bias signal and the second bias signal to generate a pre-distorted modulation signal;
  - means for propagating the pre-distorted modulation



signal through a transmission line to a modulation input of a laser, wherein an amplitude and a phase response of the pre-distorted modulation signal are substantially maintained along the transmission line; and means for modulating a laser with the pre-distorted modulation signal to generate a modulated optical signal, wherein the pre-distorted modulation signal causes at least some vector cancellation of both the second-order and the third order distortion signals generated during modulation.